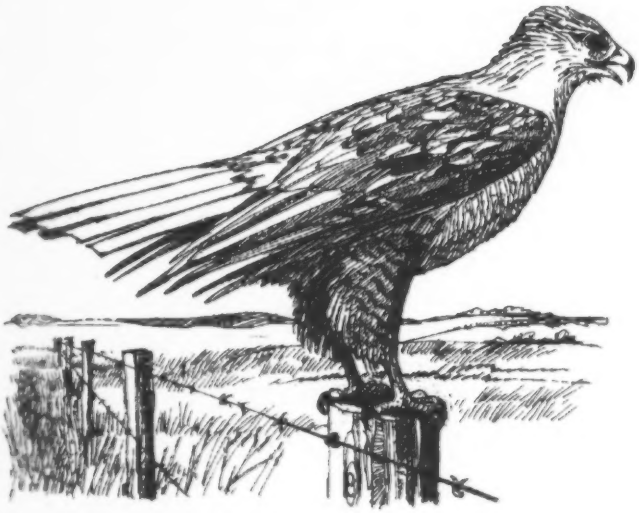
Fish & Wildlife Division

RESOURCE DATA AND SPECIES AT RISK SECTION

Alberta

Status of the Ferruginous Hawk (*Buteo regalis*) in Alberta:

Update 2006



Alberta Wildlife Status Report No. 18 (Update 2006)

Alberta Conservation Association

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Status of the Ferruginous Hawk (*Buteo regalis*) in Alberta:

Update 2006

Prepared for:
Alberta Sustainable Resource Development (SRD)
Alberta Conservation Association (ACA)

Update prepared by:
Brandy Downey

Much of the original work contained in the report was prepared by Josef K. Schmutz in 1999.

This report has been reviewed, revised, and edited prior to publication.
It is an SRD/ACA working document that will be revised and updated periodically.

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PREFACE

Every five years, the Fish and Wildlife Division of Alberta Sustainable Resource Development reviews the general status of wildlife species in Alberta. These overviews, which have been conducted in 1991 (*The Status of Alberta Wildlife*), 1996 (*The Status of Alberta Wildlife*) and 2000 (*The General Status of Alberta Wild Species 2000*), assign individual species "ranks" that reflect the perceived level of risk to populations that occur in the province. Such designations are determined from extensive consultations with professional and amateur biologists, and from a variety of readily available sources of population data. A key objective of these reviews is to identify species that may be considered for more detailed status determinations.

The Alberta Wildlife Status Report Series is an extension of the general status exercise, and provides comprehensive current summaries of the biological status of selected wildlife species in Alberta. Priority is given to species that are *At Risk* or *May Be At Risk* in the province, that are of uncertain status (*Undetermined*), or that are considered to be at risk at a national level by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Reports in this series are published and distributed by the Alberta Conservation Association and the Fish and Wildlife Division of Alberta Sustainable Resource Development. They are intended to provide detailed and up-to-date information that will be useful to resource professionals for managing populations of species and their habitats in the province. The reports are also designed to provide current information that will assist Alberta's Endangered Species Conservation Committee in identifying species that may be formally designated as *Endangered* or *Threatened* under Alberta's *Wildlife Act*. To achieve these goals, the reports have been authored and/or reviewed by individuals with unique local expertise in the biology and management of each species.

EXECUTIVE SUMMARY

The ferruginous hawk (*Buteo regalis*) is currently listed as a *Species of Special Concern* in Canada and is considered a *Threatened* species under Alberta's *Wildlife Act*. This report summarizes information about the ferruginous hawk in Alberta, as a step in updating its status in the province.

The ferruginous hawk ranges within the Great Plains of North America, breeding almost exclusively within grassland or shrub-steppe habitats. In Alberta, the species is associated with landscapes with at least 50% natural grassland and with adequate ground squirrel prey populations. Suitable breeding areas tend to occur where grazing is the dominant land use.

The distribution of the ferruginous hawk has been greatly reduced since European settlement. Estimates of range contraction include approximately 40% reduction in Alberta and 50% in Canada. Population levels in Alberta are thought to have declined by at least 50% since the 1920s. Surveys in the Grassland Natural Region between 1982 and 2005 indicate that the population significantly decreased between 1992 and 2005. The most recent population estimate (2005) of 618 (+/-162) breeding pairs is significantly less than the 1992 estimate of 1702 (+/-510). Declines in nesting pairs throughout the Grassland Natural Region are cause for concern. Threats to the survival of the ferruginous hawk in Alberta include habitat alteration through cultivation and fire suppression, variable food availability, human disturbance, and the availability of nesting sites.

The survival of the species in the province depends on the preservation of large tracts of natural grasslands with adequate prey populations. Monitoring of known nesting areas and prey populations must continue in order to assess population trends and potential limiting factors.

ACKNOWLEDGEMENTS

For the original 1999 report prepared by Josef Schmutz:

I thank Gordon Court (Alberta Environmental Protection) and Wayne Harris (Saskatchewan Environment and Resource Management) for their helpful suggestions on this manuscript. Stuart and Mary Houston kindly provided data on old egg collections. This summary of information was possible because a great many people helped secure previous funding, assisted in recording information on Ferruginous Hawks in the field, and shared ideas about conservation events and strategies. Organizations that funded past work include: Alberta Agriculture, Alberta Environmental Research Trust, Alberta Power Ltd., Alberta Sport, Recreation, Parks and Wildlife Foundation, Alberta Environmental Protection, Arctic Institute of North America, Environment Canada, Petro-Canada, Renaissance Petroleum Ltd., Special Areas Board, Hanna, University of Saskatchewan, and World Wildlife Fund Canada. Information is only as good as its parts. Many people whose work I relied on here, spent countless hours recording information meticulously. These people include Harry Armbruster (Canadian Wildlife Service), Ursula Banasch (Canadian Wildlife Service), Ron Bjorge (Alberta Environmental Protection), Steve Brechtel (Alberta Environmental Protection), Léo Dubé (Alberta Environmental Protection), Gary Erickson (Alberta Environmental Protection), Magnus Flood, Ken Froggatt (Alberta Environmental Protection), Richard Fyfe (Canadian Wildlife Service), Bob Goddard (Alberta Environmental Protection), Leo Gudmundson (Alberta Environmental Protection), Richard Griebel, Bill Hall (Alberta Environmental Protection), Ed Hofman (Alberta Environmental Protection), Dan Hungle (Special Areas Board), Sheila Schmutz (University of Saskatchewan), Helen Trefry (Canadian Wildlife Service), Ron Wheatherill (Alberta Environmental Protection), and Dan & Gwen Wood (Wild Prairie Photographics). Research assistants in the Hanna project were Doug Clayton, Doug Hooper, Jane Jenkins, Laurie King, Russell Meschishnick, David Moody, Karrie Rose, Howard Samoil, Jeff Smith, Skylar Rickabaugh, and Dave Wieder. To reach Ferruginous Hawks, rural people had to participate and I gratefully acknowledge them all. During the Ferruginous Hawk surveys, we barged in on the lives of 345 farm/ranch families. The vast majority of people were polite, many were interested, and some took us into their homes. In the Hanna study area, the travels of the "hawk man" and his entourage across the land of 27 families was a regular occurrence for 18 years. Karen and Greg Gordon, in particular, were invaluable assets to the project.

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For the 2006 update prepared by Brandy Downey:

I would like to thank Richard Quinlan (Alberta Sustainable Resource Development; ASRD), Brad Downey (Alberta Conservation Association; ACA), Brad Taylor (ACA), Leo Dube (ASRD) and Elizabeth Saunders (Sandpiper ecological research & illustration) for their recent contribution to ferruginous hawk research in Alberta. Thanks goes out to Ken De Smet (Manitoba Conservation), and Dr. Josef Schmutz (University of Saskatchewan) for sharing their experience and knowledge of the species. I would like to thank Gordon Court (ASRD), Sue Peters (ACA), Richard Quinlan (ASRD), Dr. Josef Schmutz (University of Saskatchewan), Lisa Matthias (ASRD) and Doug Collister (URSUS Ecosystem Management Ltd.) for their technical reviews of this report.

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INTRODUCTION

The ferruginous hawk (*Buteo regalis*) is one of three *Buteos* or "soaring hawks" that regularly breed in Alberta's grasslands. The species is currently listed as *Threatened** under Alberta's *Wildlife Act* and, Canada-wide, is considered a *Species of Special Concern* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2004). Currently, an update of the COSEWIC status report is in preparation.

Along with several other Alberta wildlife species, the ferruginous hawk has a restricted prairie distribution. Compared to other prairie hawks (e.g., red-tailed hawks, *B. jamaicensis*; Swainson's hawks, *B. swainsoni*), the ferruginous hawk has not adjusted well to habitat alteration on the prairies. The ferruginous hawk now occupies only part of the range it occupied around 1900.

This report summarizes historical and recent information on the ferruginous hawk in Alberta as a step in updating the status of the species in the province.

HABITAT

The ferruginous hawk is frequently described as a hawk of the "open country". The range of the species is exclusively within the Great Plains of North America, occupying flat rolling terrain in grassland or shrub-steppe regions (Bechard and Schmutz 1995). Natural Subregions in which the ferruginous hawk can be found in Alberta include: Dry Mixedgrass, Mixedgrass, Foothills Fescue and Northern Fescue (Alberta Community Development 2005). Generally, the ferruginous hawk occurs in desert shrub and grassland regions, west and east of the Rocky Mountains. In all areas except Washington (Fitzner et al. 1977), the ferruginous hawk nests where grazing is the dominant land use or where the open landscape is otherwise relatively wild (e.g., military reserves).

Although the ferruginous hawk may coexist with the red-tailed and Swainson's hawk, each of the three species of *Buteo* is specialized to exist without the others. The ferruginous hawk persists even in treeless and arid grasslands or desert habitats where it can nest on eroded banks and even relatively level ground (Bechard and Schmutz 1995). In contrast, the red-tailed hawk is strongly associated with woodlands, and, on the dry plains, relies on wooded river valleys (Godfrey 1966). The Swainson's hawk is adaptable, occupying the interface between the two habitats (England et al. 1997) and using shrubs for nesting when trees are not available. The Swainson's hawk has adapted also to agricultural activity and can be abundant in intensively cultivated regions, in marked contrast to the ferruginous hawk (Schmutz 1989).

Ferruginous hawk density within the Grassland Natural Region is related to the amount of remaining native vegetation. Ferruginous hawk nesting density decreases consistently as cultivation increases (Figure 1) and nesting hawks occur in significantly higher densities in areas with greater than 50% native grassland (Schmutz 1993, Stepnisky et al. 2002, Downey 2005). Landscapes with sufficient natural grassland for the ferruginous hawk tend to exist where cattle or sheep grazing is the dominant land use (Schmutz 1989, Schmutz 1993). On a local scale, ferruginous hawk density may increase with small amounts of cultivation (Schmutz 1993, Figure 1). This could reflect that the hawks benefit through food chain effects arising from the agricultural inputs that elevate productivity, or that continuous grasslands, without natural disturbances such as wildfires, are inherently lower in prey productivity. For example, across randomly selected study plots in Alberta, ferruginous hawk breeding density exhibited a pattern similar to the abundance of its main prey, ground squirrels. Both hawks and

* See Appendix 1 for definitions of selected status designations.

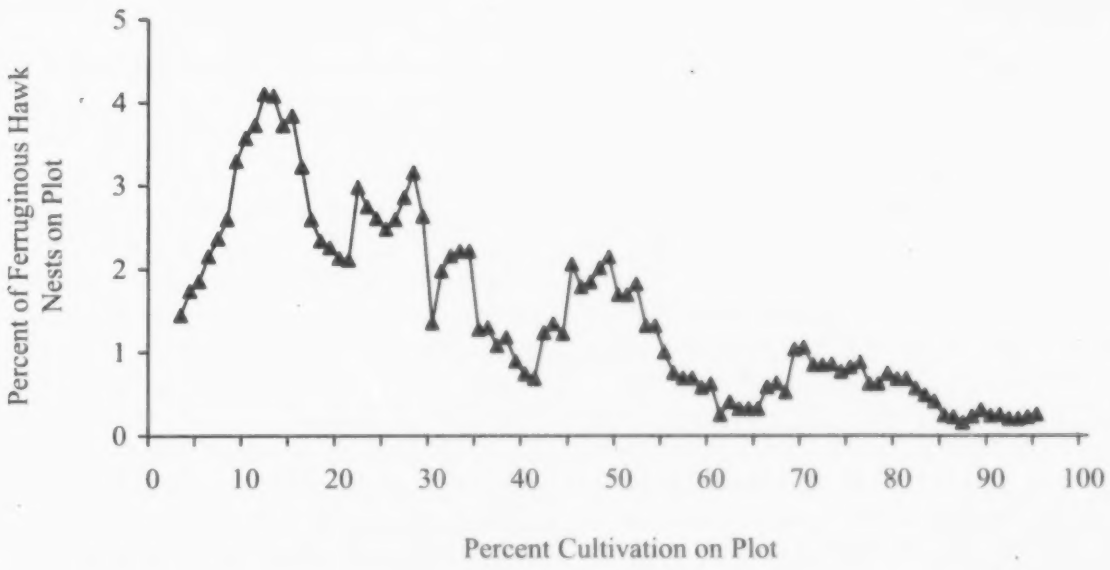

Figure 1. Percent of ferruginous hawk nests in relation to percent cultivation on study plots surveyed in 1982, 1987 and 1992 (see Population Size and Trend section; Schmutz 1993).

ground squirrels increased as the proportion of cultivation on plots increased, peaked, and then declined as cultivation exceeded 50% (Schmutz 1989, Downey et al. 2006).

CONSERVATION BIOLOGY

Ferruginous hawks are usually monogamous and initiate pair bonds each breeding season (Bechard and Schmutz 1995). There are no identified subspecies or races recognized. Major differences in appearance of individuals result from variation in plumage (Bechard and Schmutz 1995). A dark morph occurs in approximately 10% of individuals and appears black on the belly, back and wings from a distance. This contrasts with the more common light morph, whose feathers on back, legs and wings are a mix of rusty "ferruginous" brown, gray and white. Both morphs have a grayish tail.

These large hawks (males 977-1347 g; females 1501-2074 g) arrive in Alberta in late March to early April (Schmutz et al. 1980, Dolman 1994). Pairing takes place before or soon after arrival on the nesting grounds. The ferruginous hawk may use a variety of nesting structures such as trees, abandoned farmsteads, ledges on cliffs, or level ground. Ground-nesting was likely more prevalent in the past (Rolfe 1896), before trees became more common as a result of post-settlement fire suppression and the planting of shelterbelts (Bechard and Schmutz 1995). On average, hawks produce more young in elevated nests than ground nests, likely as a result of placing nests further out of reach of predation and disturbance (Fitzner et al. 1977, Schmutz et al. 1984). Ferruginous hawks are also more prone to initiate breeding when suitable nest sites are available (Schmutz et al. 1988), and nests on near-level ground appear to be used only under extreme elevated nest site shortages and a superabundance of food. Nest building starts in April and females lay one to five (mean 3.6; Schmutz and Hungle 1989) eggs, brown-spotted on white, in April or early May.

Only the female ferruginous hawk incubates, although the male may shelter eggs briefly. Hatching occurs after approximately 32 days. The male is the main provider of food, especially prior to fledging. Ferruginous hawks have been known to breed as early as their second year (Schmutz et al. 1994).

Between 1975 and 1977 in a total of 70 nests near Hanna, hatching commenced over a 15-day period, with mean dates of June 4, May 26 and 27, respectively (Schmutz et. al. 1980). Hatching success in Alberta is generally high, and an average of 2.1 young per occupied nest survive to fledging at five to six weeks of age (Schmutz and Hungle 1989). Mortality is high (estimated at 65%; Schmutz and Fyfe 1987) during the first year, but much lower among adults (estimated at 25%; Woffinden and Murphy 1989). Fledglings and adults generally remain in the vicinity of the nest for one month. In August, young drift away and begin their migration. Adults follow later, remaining as late as mid-October (Bechard and Schmutz 1995).

Throughout its range, the ferruginous hawk relies primarily on only two families of mammals for the majority of its food: Leporidae (rabbits and hares) and Sciuridae (ground squirrels and prairie dogs). Collating results from 20 diet studies in the United States and Canada, Olendorff (1993) reported that rabbits and hares composed 66% of the ferruginous hawk's diet by biomass (20% by items), and ground squirrels and prairie dogs 25% by biomass (44% by items). In contrast to the desert-shrub ecosystems in the western United States, however, jackrabbits (*Lepus townsendii*) have played a minor role in the diet of the ferruginous hawk in Alberta, where it shows an overwhelming reliance on ground squirrel prey (Schmutz et al. 1980).

Alberta-based evidence suggests a strong link between ferruginous hawk density and/or reproductive success and ground squirrel abundance. Schmutz et al. (1980) found that ground squirrels (largely Richardson's ground squirrels: *Spermophilus richardsonii*) were the most important prey item for the ferruginous hawk overall, and that during the nestling period ground squirrels represented 89% of prey items. In 2003, a study of the relationship between the Richardson's ground squirrel and the ferruginous hawk was initiated (Downey 2003). Preliminary analysis indicates that ground squirrel densities are positively correlated with the number of ferruginous hawk nests found within a sample unit (B. Downey pers. comm.).

The ferruginous hawk produces larger clutches than other *Buteo* species that nest at the same latitude (Newton 1979). *Buteo* hawks that rely mostly on rodent prey also show the greatest fluctuations in reproduction in response to rodent prey density (Newton 1979). Specialization on ground squirrel prey may be why the ferruginous hawk reproduces so well in years of high ground squirrel numbers (see Schmutz and Hungle 1989).

The possibility of reduced genetic variability in the ferruginous hawk has been suggested based on the extensive habitat loss and isolation of some ferruginous hawk populations in Canada. As well, the possible population decline (bottleneck) during the drought and ground squirrel low of the 1930s may have reduced genetic variability (Houston and Bechard 1984). Portman (1997) sampled one nestling ferruginous hawk from each of 94 nests in eight study populations over an area stretching from southwestern Manitoba through southern Alberta and southeastern Idaho. Molecular-band sharing among DNA fingerprints and estimates of heterozygosity suggested that genetic diversity among the sampled populations is high, and similar to other populations of outbred birds (Portman 1997). An analysis of population subdivision indicated that there is considerable gene flow among ferruginous hawk populations across the northern prairies (Portman 1997). However, a local population of ferruginous hawks near High River is an exception and is somewhat unique (Portman 1997). The High River population nests in a western remnant of grassland and it is possible that this habitat fragment is sufficiently isolated that only locally produced, and thus genetically related, ferruginous hawks return to nest there.

DISTRIBUTION

1. Alberta. – A comparison of the current distribution of the ferruginous hawk and historical records of egg collectors and naturalist explorers of the prairies suggests at least a 40% reduction in the species' breeding distribution in Alberta (Schmutz 1984). While travelling from Yorkton, Saskatchewan to Edmonton, Macoun and Macoun (1909) noted ferruginous hawks "regularly and commonly." Godfrey (1966) reported the Alberta range of the ferruginous hawk as extending north to near Alliance (east of Red Deer). Today, a line through Waterton Lakes National Park-Calgary-Drumheller-Hanna-Consort-Altario represents the northern and western edge of the hawk's range, with only a few isolated pairs existing north and west of this edge (Figure 2).

Historically, there appears to have been a southeasterly contraction of the ferruginous hawk's range. This is suggested by the observations of bird watchers and raptor banders in the province. For instance, in 1994, a fledgling not yet able to fly was recorded a few kilometres south of Stettler on Highway 56 (H. Trefry pers. comm.), indicating the presence of a successful breeding pair in the area. This was likely the result of one of the scattered pairs that occur along the northern edge of the currently defined range. Similarly, in the late 1980s, observations of nesting pairs of ferruginous hawks included one pair approximately 30 km north-northeast of Hanna, two pairs west of Sullivan Lake (south of Castor), and one pair 15 km east of Castor (D. Wood pers. comm.). The Rosebud Coulee, south-southwest of Drumheller, supported many ferruginous hawks in the past, based on the banding results of Salt (1939). However, during a thorough reconnaissance of the Rosebud River Valley and its tributaries in the 1980s, two adults and many old nests were observed but no occupied nests were found (R. Bjorge pers. comm.). Near Drumheller in 1988, no occupied ferruginous hawk nests were observed and five abandoned nests were noted along a 20-km stretch of the Red Deer River (J. Schmutz unpubl. data). Though there are the occasional ferruginous hawk nests found in the north and far west parts of the former range, these numbers are negligible (Schmutz 1987a, Taylor and Iwassa 2000, Stepnisky et al. 2002). The majority of the population resides in the central and eastern parts of the Grassland Natural Region.

2. Continental Range. - The ferruginous hawk occurs primarily in western North America. Its breeding range includes 17 states and 3 provinces from the southern prairie provinces south to northern Arizona and New Mexico (Bechard and Schmutz 1995; Figure 3). The winter range extends from northern California, east to southwestern Nebraska and south to east-central Texas, central Mexico and Baja California (see Bechard and Schmutz 1995). The majority of ferruginous hawks that breed in Alberta, winter in Texas (Schmutz and Fyfe 1987).

Approximately 12% of the ferruginous hawk's breeding range occurs within Canada (Schmutz and Schmutz 1980). In 1980, at the time the ferruginous hawk was listed as *Threatened* by COSEWIC, the species was believed to occupy approximately 48% of its former range in Canada (Schmutz and Schmutz 1980). Patterns of range decline in other provinces have been similar in timing and apparently reflect similar habitat changes as have occurred in Alberta. Likely always rare in British Columbia, a handful of individuals, at most, currently breed in the interior of the province (Campbell et al. 1990). In Saskatchewan, the ferruginous hawk has retreated southwesterly to areas where ranching on native range predominates (Houston and Bechard 1984). However, ferruginous hawks still occur in that province on isolated community pastures in areas of otherwise extensive crop production (Banasch et al. 1994). After a period of absence, a small population of ferruginous hawks now exists in

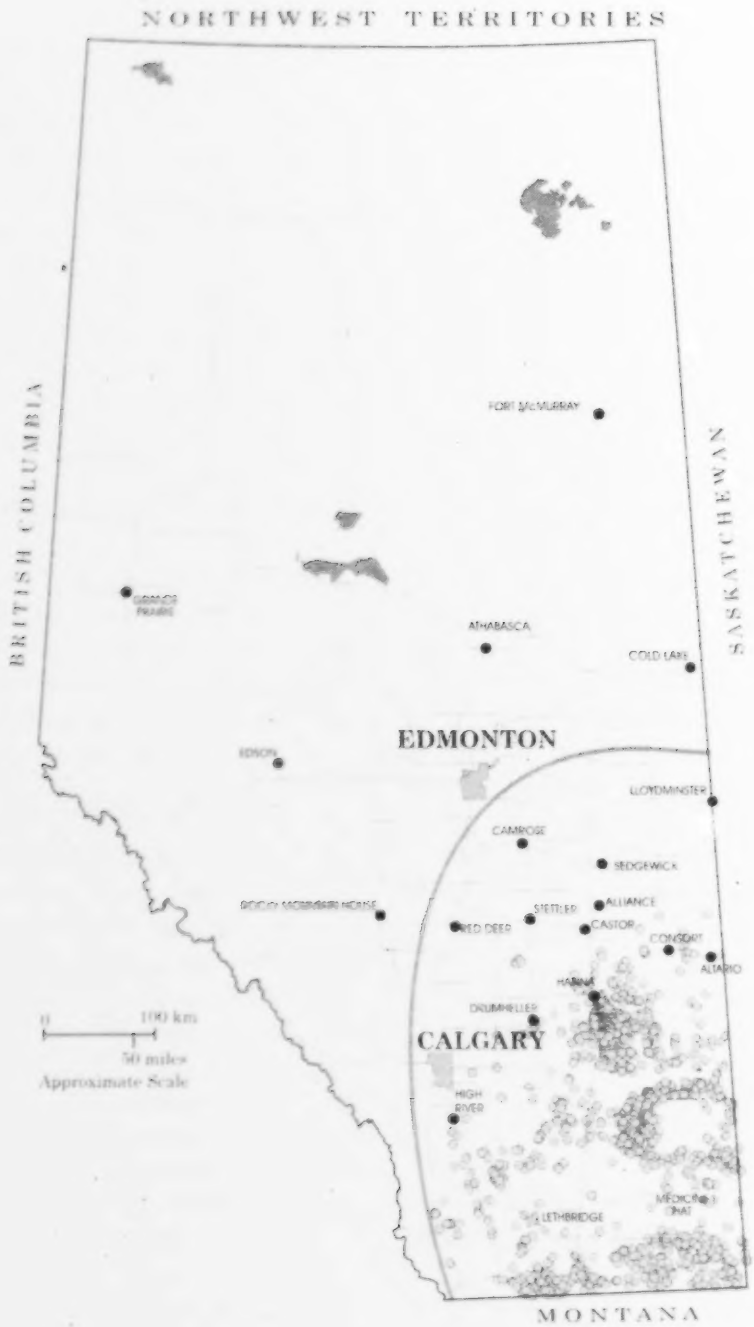

Figure 2. Distribution of the ferruginous hawk in Alberta based on observational records from 1958 to 2005. The grey line indicates the ferruginous hawk's historical range (Schmutz and Schmutz 1980).

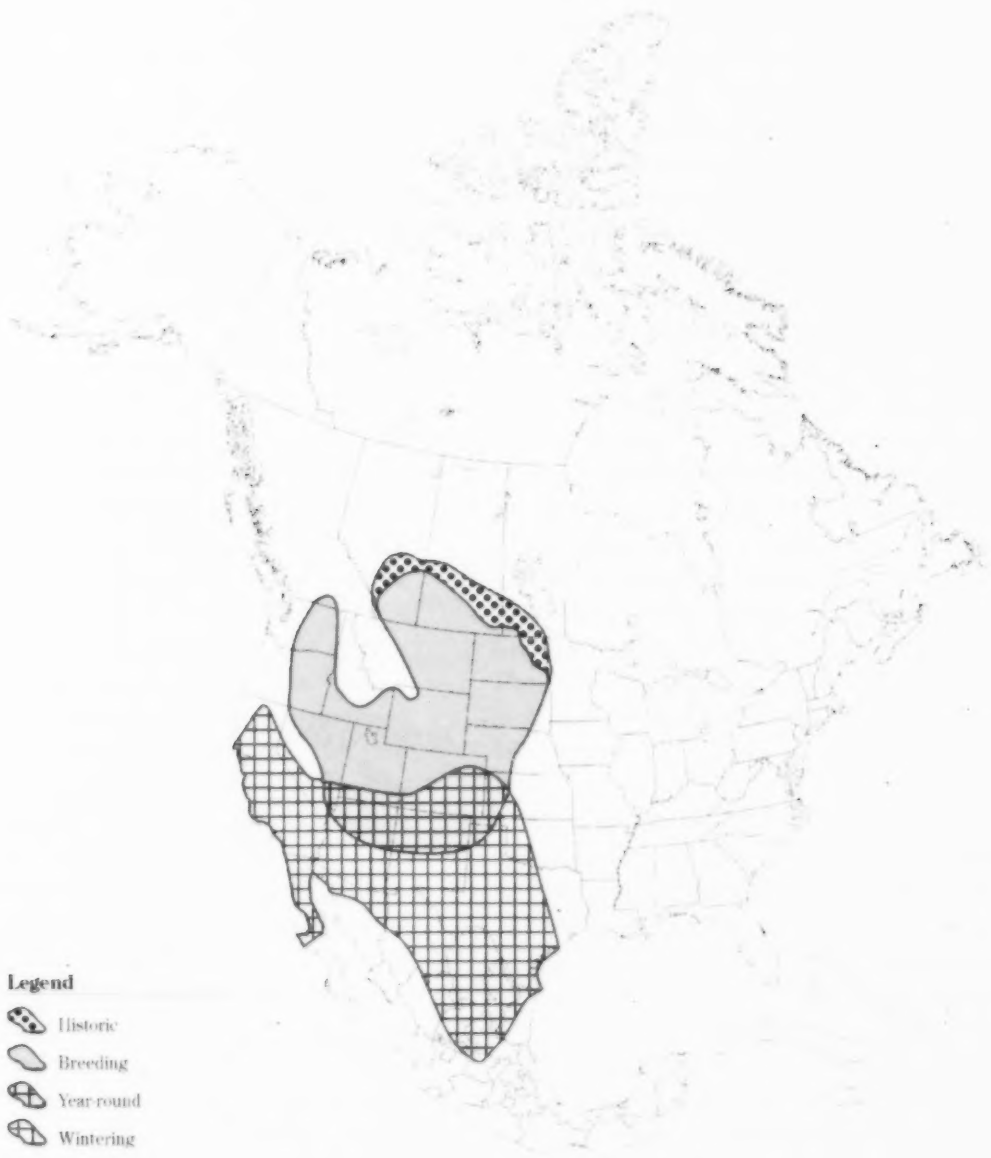

Figure 3. Distribution of the ferruginous hawk in North America showing the range contraction in the southeastern portion of the species' range (modified from Schmutz and Schmutz 1980, Bechard and Schmutz 1995).

extreme southwestern Manitoba (K. De Smet pers. comm.).

In Canada and the United States, range maps underestimate the degree of decline in ferruginous hawk populations because they do not show the substantial decreases in numbers that have occurred within the range. The vacancy of many historical nest sites during the 1980s has suggested reductions in numbers within the ferruginous hawk's core breeding range (Bechard and Schmutz 1995). Throughout their range, ferruginous hawk numbers have reportedly declined in comparison to their distribution several decades ago.

POPULATION SIZE AND TRENDS

1. Alberta - Data suggest that Alberta supports 12% to 37% of the continent's ferruginous hawks in the grassland population east of the Rocky Mountains (Schmutz 1987b). However, a percentage larger than 20% is probably an overestimate, because for a 16 519-km^2 portion of North Dakota alone, Gilmer and Stewart (1983) estimated 618 and 1154 breeding ferruginous hawk adults (4% to 8% of the grassland population) in two different years. Much of the ferruginous hawk's remaining breeding range has not been surveyed. The number of ferruginous hawks in Alberta is a dynamic outcome of recruitment and mortality modified by dispersal. Therefore, population estimates are difficult to come by; however, they provide the best insight into the dynamics of this species and illustrate that Alberta supports a substantial portion of the North American population of ferruginous hawks.

Accurate historical population estimates for the ferruginous hawk do not exist. By 1980, however, based on qualitative evidence provided by naturalists and bird enthusiasts, Schmutz and Schmutz (1980) estimated that numbers of ferruginous hawks had been reduced by at least half since the 1920s. Over the more recent past, a population trend estimate is available, mainly through coordinated survey efforts (Schmutz 1993, Stepnisky et al. 2002, Downey 2005). Surveys on 80 to 83 randomly selected, 41-km^2 study plots in the prairie region of southern Alberta were conducted in 1982 (Schmutz 1984), 1987 (Schmutz 1989), 1992 (Schmutz 1993) and 2000 (Stepnisky et al. 2002). The survey region is situated south of Consort, southeast of Drumheller, and east of High River, and likely includes 95% of Alberta's breeding ferruginous hawks (Schmutz 1993).

The survey results showed an increase in the estimated breeding pairs in southeastern Alberta from 1982 to 1987 (but note that the study area size increased by over 3000 km^2), a slight decrease from 1987 to 1992, and a dramatic decline between 1992 and 2000 (Schmutz 1993, Stepnisky et al. 2002). However, the large confidence limits in the population estimates resulted in debate over the precision of the survey techniques. As a result, two reviews were carried out that recommended that the survey quadrats be divided into two strata (high $\geq$50% native prairie habitat and low <50% native prairie habitat) and that the number of quadrats be increased from 83 to 150 (Taylor 2003, Saunders 2005). These changes were implemented during the 2005 inventory and resulted in an increased confidence in the population estimate (Downey 2005). The 2005 population estimate of 618 +/- 162 pairs is the lowest population estimate to date and is less than half of the 1992 estimate (Figure 4, Appendix 2).

In addition to the 2005 provincial inventory, a subsample of 30 quadrats (41-km^2 each) was surveyed in 2000, 2003, 2004 and 2005 to determine population trend (Taylor 2003). Quadrats were selected at random throughout the study area and the number of pairs counted in each was compared using linear regression (Downey 2005). No significant trend in the number of nests/quadrat was observed between 2000 and 2005 (Figure 5), indicating that the population is currently stable and that the

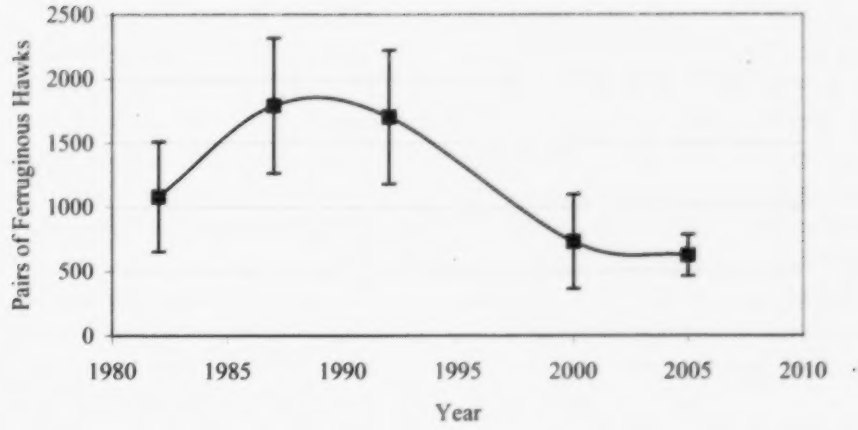

Figure 4. The number of estimated pairs of ferruginous hawks in southeastern Alberta, 1982-2005 (Downey 2005). Error bars represent +/-1 SE.

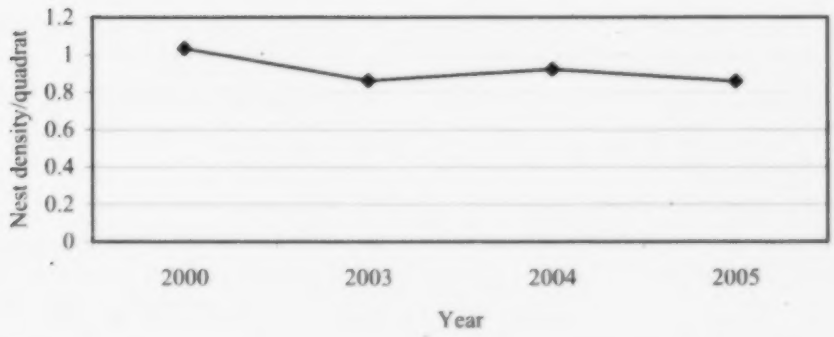

Figure 5. The density of ferruginous hawk nests on a subsample of 30 quadrats within the Grassland Natural Region, during 2000-2005 (Downey 2005).

decline from historical numbers probably occurred before 2000. Another comparable estimate of the ferruginous hawk population (852 +/- 460 pairs) was attained during the 2001 long-billed curlew inventory (Saunders 2001), which corroborates the 2000 estimate from the ferruginous hawk inventory (see Figure 4).

This most recent decline in ferruginous hawks may have been caused by a decrease in ground squirrel numbers (Jones 1993, J. Schmutz unpubl. data). A similar trend in ferruginous hawk numbers also took place in a study area near Hanna where surveys were carried out for 18 years during the 1975 to 1995 period (Schmutz and Hungle 1989, Schmutz 2004). After approximately 11 years of population stability or increase, the number of breeding ferruginous hawks and their brood size declined precipitously, starting in 1990 (Figure 6). This decline was concurrent with a decline in numbers of ground squirrels in the study area (J. Schmutz unpubl. data).

The most recent trend information (2003-2005) indicates a slight increase over the three-year period in ground squirrel densities on ferruginous hawk survey quadrats (B. Downey pers. comm.). This may explain why the ferruginous hawk population has been exhibiting a stable trend since the population decline of the 1990s. A detailed analysis of the relationship between ferruginous hawks and Richardson's ground squirrels is currently being conducted and results are expected in early 2006.

2. Other Areas. - Data from the Christmas Bird Counts (CBC) and hawk watching stations in the United States provide trends for many raptors, including ferruginous hawks. Taylor (2003) compared the results of the Alberta 5-year inventories to the CBC in Texas, New Mexico, Oklahoma, Colorado and Kansas (Figure 7). It was found that the CBC data exhibit a similar trend to the Alberta population.

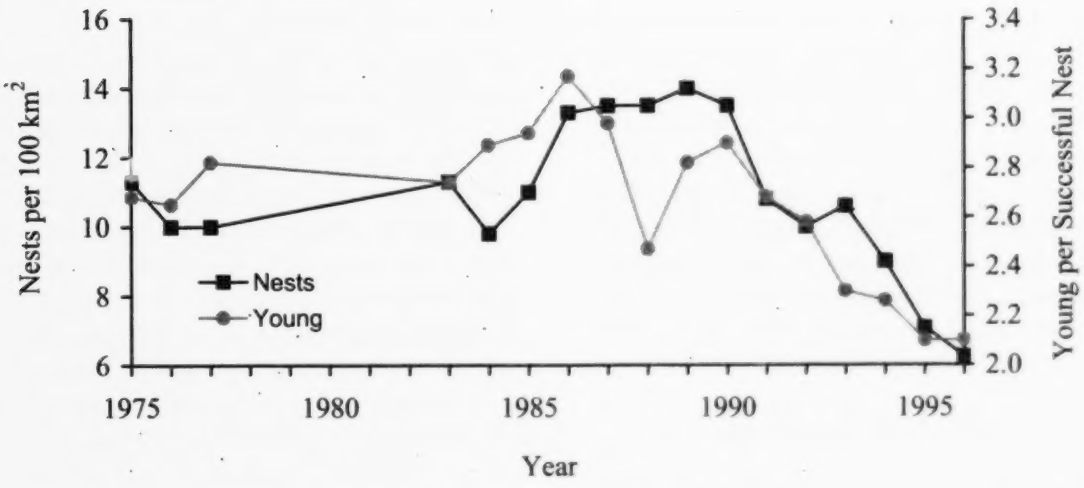

Figure 6. Change in the number of ferruginous hawk nests is shown for a 326-480 km2 study area in Alberta, between 1975 and 1996 (Schmutz 2004). The number of young per nest was recorded near the time of fledging for nests from which at least one young fledged. Surveys were not conducted between 1978 and 1982.

Figure 7. Comparisons of Alberta population estimates and CBC data from Texas, New Mexico, Oklahoma, Colorado, and Kansas.

As an approximation of the number of ferruginous hawks in adjacent prairie provinces, Schmutz (1993) suggested 1000 to 1500 pairs in Saskatchewan and approximately 50 pairs in Manitoba. Recent surveys in Manitoba suggest that a range of 32-55 ferruginous hawk pairs occur in the southeast part of the province (K. De Smet pers. comm.). Estimates of the entire population of ferruginous hawks vary. Schmutz (1987a) estimated the size of the entire grassland population (east of the Rocky Mountains) of ferruginous hawks to be 14 000 individuals or 7000 pairs. Based on reports from across the ferruginous hawk's range in Canada and the United States, Olendorff (1993) reported a lower population estimate for 1992 of between 2921 and 5665 pairs.

LIMITING FACTORS

Limiting factors for the ferruginous hawk include the following: 1) those that reduce reproductive success, either directly or indirectly, or 2) those that increase adult or juvenile mortality. It should be noted that late spring snowstorms and natural prey fluctuation can negatively affect the species; however, this section focuses on those factors that are influenced by human activities.

1. Habitat Alteration. - Post-settlement habitat alteration has resulted in three factors that have negatively affected ferruginous hawk populations. First, soils within the northern part of the ferruginous hawk's range are reasonably well suited to crop production and have been extensively cultivated, thus rendering this habitat unsuitable for the species (see Habitat section, above). Fire suppression has further altered this landscape, as well as the Foothills Fescue, by allowing woodland habitat to expand and replace some remaining patches of grassland (see Houston and Bechard 1983). Finally, following this conversion of grassland to woodland, Swainson's and red-tailed hawks have expanded their range to potentially compete with ferruginous hawks for space, food and nest sites (Schmutz et al. 1980).

Within its current range, the ferruginous hawk's fragmented distribution appears strongly associated with remaining grassland. In areas

where it still occurs, the ferruginous hawk may be highly sensitive to any further loss of habitat and may also be unusually vulnerable to disturbance. For instance, alternate hunting grounds may be unavailable to the hawks in the case of a disturbance. Therefore, in a large portion of their range the survival of these hawks is dependent on a traditional ranching economy where native range prevails.

Perhaps the most far-reaching recent influence assisting the ferruginous hawk is the discontinuation or re-examination of various direct or indirect subsidies that encourage breaking of grasslands. For example, the Canadian Wheat Board removed acreage quotas (Thornton et al. 1993) for barley and wheat in 1993-94 and the Western Grain Transportation Act's subsidy for the transport of grain was discontinued in 1995. The ferruginous hawk and other prairie wildlife have likely benefited from the encouragement of diversification in agriculture and a return to permanent cover on some marginal lands. However, crop insurance programs can indirectly encourage the cultivation of marginal lands by providing insurance for those years when yields are low.

The lack of strong public lands policy for preservation of remaining native grasslands, and recent public/private land trades leading to net loss of native grasslands, is an ongoing threat to wildlife dependent on native grasslands, including the ferruginous hawk.

2. Food. - Based on abundant and reasonably strong evidence, it appears that ferruginous hawk conservation in Alberta is inextricably tied to maintaining the ground squirrel prey base (Schmutz 1993, Downey et al. 2006). Therefore, the use of pest control methods on the ground squirrel may contribute to the decline in the ferruginous hawk population.

Selective poisoning of ground squirrels to guard against damage to cereal crops does not appear to have a major influence on the hawks through secondary poisoning (Schmutz et al. 1989). Remarkably, there is no evidence that ferruginous hawks have been negatively affected by pesticides (Bechard and Schmutz 1995). Although deferred or indirect deaths likely go unnoticed, it is possible that ferruginous hawks are largely uninfluenced by pesticides. Unlike other raptorial birds (e.g., peregrine falcon) that rely on migratory bird species as their main prey, the ferruginous hawk's simple food chain has few linkages (plants-sciurids-hawks), and only marginally includes insect prey or aquatic habitats where agrochemicals are readily transported. However, the removal of ground squirrels may affect hawks that utilize small parcels of grassland within intensive farming areas where they have little or no opportunity to shift to alternate hunting grounds (B. Downey pers. comm.).

3. Availability of Nest Sites. - Although the ferruginous hawk has vacated the northern parts of its range where trees have invaded as a result of current fire suppression methods, in the south the species largely depends on trees or similar raised structures for nesting. The ferruginous hawk prefers elevated nest sites because of the protection they offer, and the species frequently uses trees in abandoned farmsteads. Grazing cattle and ungulates can hinder tall shrub and tree recruitment, further reducing the amount of potential nesting substrate. In areas where trees have died and fallen or in areas where few trees are available, artificial elevated nesting platforms have proven to be a useful management tool (Bechard and Schmutz 1995).

In addition to using tree nests, a small number of ferruginous hawks are found to nest on sandstone cliffs and rocky outcrops (Downey and Quinlan 2005). Though these areas are generally restricted to river valleys and badland areas, they provide a number of birds with nesting sites. The porosity of these sandstone cliffs makes them highly susceptible to erosion. As a result, these structures, and the nests they

support, can be damaged through recreational use, industrial developments and natural events (Green et al. 2004).

4. Human Disturbance. - The effect of different kinds of human disturbance on ferruginous hawks varies among individuals (White and Thurow 1985). Newton (1979) reported that the ferruginous hawk is sensitive to disturbance at the nest and is likely to desert if disturbance occurs during the egg stage. White and Thurow (1985), however, found that the response of the hawks to disturbance depended on the origin and intensity of that disturbance. The effects of human activities that were familiar to the hawks, especially if humans were not visibly associated with those activities, were quite benign (White and Thurow 1985). In contrast, unfamiliar disturbances caused some hawks to desert their nests, even after the hawks were apparently accustomed to other forms of disturbance (White and Thurow 1985). It is evident that ferruginous hawks nesting in disturbed areas fledge significantly fewer young than do hawks in relatively undisturbed areas (White and Thurow 1985).

Although it is relatively easy to monitor and avoid disturbance at nest sites, the subtle effects of a general disturbance over a larger area are much more difficult to assess. A study in Idaho revealed that fewer raptors, including ferruginous hawks, used an area in years when military exercises were carried out (U.S. Department of the Interior 1996). The raptors that did use the area made only half as many prey capture attempts compared to those in undisturbed areas (U.S. Department of the Interior 1996).

5. Industrialization and Human Development. - Industrial developments such as pipelines, oil wells and compressor stations are increasing on the prairies at an alarming rate. Such development causes habitat fragmentation, promotes invasive species, and increases other human activity in wild areas. The ferruginous hawk is negatively affected by such developments because of the loss of nesting sites, increased disturbance, and habitat fragmentation (Newton 1979, White and Thurow 1985, Dechant et al. 2001, Stepnisky et al. 2002). More recently, wind farms have been introduced to Alberta's prairie landscape. Although wind farms provide clean energy, they can negatively affect species such as the ferruginous hawk as a result of direct mortalities and nest abandonment (Alberta Sustainable Resource Development 2005).

Documented mortality data for the ferruginous hawks indicate that many deaths are related to human causes. Twenty-five known or suspected causes of death of recovered ferruginous hawks included 32% by shooting, 32% collision with a vehicle, 20% found injured/sick, and 4% each killed by another raptor, striking a powerline, electrocution and starvation (Schmutz and Fyfe 1987). A review of the Fish and Wildlife Information Management System (FWMIS) revealed no recent records of hawk deaths. This may be because of a lack of reporting of hawk deaths in Alberta.

The cumulative effect of such development on the prairie landscape and on the species that rely upon it is still unknown. However, it is clear that ongoing and increasing development and the human disturbance that is caused directly and indirectly by it is altering native prairie habitat. The ferruginous hawk relies heavily on open undisturbed grasslands for nesting and feeding habitat and any changes to the habitat will affect the ferruginous hawk population.

6. Migration and Wintering Grounds. - Pressures similar to those occurring in Canada are also occurring in the United States and Mexico. Alberta ferruginous hawks migrate through the eastern Great Plains, and during winter many are concentrated in western Texas (Bechard and Schmutz 1995). As long as breeding populations in the Great Plains grasslands remain healthy, it may be assumed that these areas can also support migrants.

Currently, a study identifying major breeding and overwintering habitat for the ferruginous hawk has been initiated (Ferruginous hawk.org 2005).

During the ferruginous hawks' migration between summer and wintering grounds, they may encounter early winter storms, wind farms, telecommunications towers and other human developments that can cause direct mortalities. Though the exact numbers of these are unknown, during low production years they may be significant.

STATUS DESIGNATIONS*

1. Alberta. - The ferruginous hawk is currently listed as a *Threatened* animal under Alberta's *Wildlife Act* (ESCC 2003). The species' general status was down-listed from the 1991 provincial Red List to the Blue List in 1996, because although a substantial decline in their range had occurred, hawk numbers had stabilized and the population was apparently not threatened by chance events exacerbated by small population size (Alberta Fish and Wildlife 1991, Alberta Wildlife Management Division 1996). The *General Status of Alberta Wild Species 2000* report ranks the ferruginous hawk as *At Risk* (Alberta Sustainable Resource Development 2001).

2. Other Areas. - The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed the ferruginous hawk as *Threatened* in 1980. The ferruginous hawk was down-listed by COSEWIC from *Threatened* to *Vulnerable* in 1995 (Schmutz 1995), because even though a substantial decline in the species' range had occurred, hawk numbers had stabilized and the population was apparently not threatened by chance events exacerbated by small population size (G. Court pers. comm.). The *Vulnerable* designation was recently replaced by the term *Species of Special Concern* (COSEWIC 2004).

Globally, the ferruginous hawk is ranked G4, meaning the species is "apparently secure" (NatureServe 2005). In Saskatchewan, the species has a provincial rank of S4 and the species is currently being considered for provincial listing. The ferruginous hawk is listed as *Threatened* in Manitoba (Manitoba Conservation 2005), and it is considered S1 or "critically imperilled" in British Columbia (Nature Serve 2005). State ranks in the United States generally range from S4 ("apparently secure") in the northeastern portion of the ferruginous hawk's range to S2 ("imperilled") in the northwest (NatureServe 2005). The ferruginous hawk is not listed by the U.S. Fish and Wildlife Service.

RECENT MANAGEMENT IN ALBERTA

Artificial nests have been used in Alberta as a tool to enable ferruginous hawks to nest in areas where trees are scarce and to reduce the impacts of nest predation and disturbance (Schmutz et al. 1984). Ninety-eight nest platforms erected in 1975 were monitored for ferruginous hawk use from 1976 to 1983 (Schmutz et al. 1984). Early results showed that ferruginous hawk nesting density had increased following the erection of nesting platforms and, as well, reproductive success was higher in elevated nests (Schmutz 1984). Approximately 3% of Alberta's ferruginous hawk population used artificial nests in the mid-1980s (Schmutz et al. 1984, Schmutz et al. 1988, Schmutz 1993). However, during the most recent (2005) provincial survey, observers noted that many platforms had been removed or damaged. Continued positive benefit of artificial nest platforms will depend on their maintenance and repair of damage.

A Habitat Suitability Index (HSI) model has been developed for the species, which identifies highly suitable habitat within

* See Appendix 1 for definitions of selected status designations.

the Grassland Natural Region of Alberta (Taylor 2004). This was done in part with a stewardship program designed to conserve/maintain habitat for prairie wildlife in the southern parts of the province. This model is currently being further developed by Alberta's Fish and Wildlife Division and will be used in industrial reviews to identify areas that may be important to the ferruginous hawk. In addition, Beneficial Management Practices have been developed for the ferruginous hawks, which can be applied in key habitat areas (Rangeland Conservation Service 2004). Recently, a North American action plan was developed for the ferruginous hawk (NACAP 2005). The aim of that document is to facilitate a long-term conservation agenda for the species.

SYNTHESIS

The dramatic population decline over the last decade suggests that the persistence of the ferruginous hawk is currently in jeopardy in Alberta. The species is dependent on an adequate prey base and large areas of open grassland. The changes on this landscape coupled with natural events, such as late snowfalls, are likely causing these declines. There can be little doubt that the key to the conservation of the ferruginous hawk in Alberta lies in the protection of rangeland and the prairie wildlife community. More specifically, the survival of the ferruginous hawk in Alberta is closely linked to the perpetuity of large areas of contiguous grasslands in southeastern Alberta, managed under a traditional ranching economy. Generally, cattle grazing ensures habitat that includes some apparently important elements for ferruginous hawks: large areas with low disturbance, and native range where plant species diversity is high, and where some plant cover is available year-round for rodent prey. The ferruginous hawk tolerates an agricultural habitat mosaic where grasslands fitting this description represent 50% or more of the landscape. The integrity of such grassland systems must be conserved under increasing human pressure to ensure the survival of the species, through government policies on the sale/transfer of public land and stewardship programs on private land. These programs should encourage the maintenance of native prairie habitat and education on the importance of prey species to the prairie ecology.

Additional anthropogenic factors that may negatively affect the species include the following: industrial development, global warming, the widespread impacts of aerosol pollutants (for example, see Wedin and Tilman 1996) on range productivity, and an increasing human population. The long-term cumulative effects of such factors on the prairie ecosystem on which the ferruginous hawk depends needs to be studied and considered seriously when management and development decisions are made.

The future of Alberta ferruginous hawks is not solely dependent on conditions in Alberta. In order to guarantee the survival of the ferruginous hawk and a significant proportion of other threatened species, conservation initiatives must have not only a provincial focus but also an inter-provincial and international dimension.

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Appendix 1. Definitions of selected legal and protective designations.

A. The General Status of Alberta Wild Species 2000 (after Alberta Sustainable Resource Development 2001)

2000 Rank	1996 Rank	Definitions
At Risk	Red	Any species known to be *At Risk* after formal detailed status assessment and designation as *Endangered* or *Threatened* in Alberta.
May Be At Risk	Blue	Any species that may be at risk of extinction or extirpation, and is therefore a candidate for detailed risk assessment.
Sensitive	Yellow	Any species that is not at risk of extinction or extirpation but may require special attention or protection to prevent it from becoming at risk.
Secure	Green	Any species that is not *At Risk*, *May Be At Risk* or *Sensitive*.
Undetermined	Status Undetermined	Any species for which insufficient information, knowledge or data is available to reliably evaluate its general status.
Not Assessed	n/a	Any species known or believed to be present but which has not yet been evaluated.
Exotic/Alien	n/a	Any species that has been introduced as a result of human activities.
Extirpated/Extinct	n/a	Any species no longer thought to be present in Alberta (*Extirpated*) or no longer believed to be present anywhere in the world (*Extinct*).
Accidental/Vagrant	n/a	Any species occurring infrequently and unpredictably in Alberta, i.e., outside its usual range.

B. Alberta Wildlife Act/Regulation

Species designated as Endangered under Alberta's *Wildlife Act* include those listed as *Endangered* or *Threatened* in the Wildlife Regulation.

Endangered	A species whose present existence in Alberta is in danger of extinction within the next decade.
Threatened	A species that is likely to become endangered if the factors causing its vulnerability are not reversed.

C. Committee on the Status of Endangered Wildlife in Canada (after COSEWIC 2005)

Extinct	A species that no longer exists.
Extirpated	A species that no longer exists in the wild in Canada, but occurs elsewhere.
Endangered	A species facing imminent extirpation or extinction.
Threatened	A species that is likely to become endangered if limiting factors are not reversed.
Special Concern	A species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
Not at Risk	A species that has been evaluated and found to be not at risk given current circumstances.
Data Deficient	A species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction.

Appendix 1 continued.

D. Heritage Status Ranks: Global (G), National (N), Sub-National (S) (after Alberta Natural Heritage Information Centre 2004, NatureServe 2005)

G1/N1/S1	5 or fewer occurrences or only a few remaining individuals. May be especially vulnerable to extirpation because of some factor of its biology.
G2/N2/S2	6 to 20 or fewer occurrences or with many individuals in fewer locations. May be especially vulnerable to extirpation because of some factor of its biology.
G3/N3/S3	21 to 100 occurrences, may be rare and local throughout its range, or in a restricted range (may be abundant in some locations). May be susceptible to extirpation because of large-scale disturbances.
G4/N4/S4	Typically > 100 occurrences. Apparently secure.
G5/N5/S5	Typically > 100 occurrences. Demonstrably secure.
GX/NX/SX	Believed to be extinct or extirpated, historical records only.
GH/NH/SH	Historically known, may be relocated in the future.
GNR/NNR/SNR	Unranked—conservation status not yet assessed.

E. United States Endangered Species Act (after National Research Council 1995)

Endangered	Any species which is in danger of extinction throughout all or a significant portion of its range.
Threatened	Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Appendix 2. The estimated number of pairs of ferruginous hawks in southeastern Alberta, 1982-2005.

Year	Number of Quadrats	Study Area (km^2)	Estimated Number of Pairs	95% Confidence Limits	95% Confidence Intervals
1982*	80	74 686	1082	+/- 438 (40.5%•)	643-1520
1987*[a]	83	77 947	1791	+/- 510 (28.5%)	1280-2301
1992	85	77 947	1702	+/- 520 (30.6%)	1181-2223
2000+	86	77 947	731	+/- 366 (50.1%)	364-1097
2005▽	147	77 157	618	+/- 162 (26.2%)	456-780

[a] An additional 3261 km^2 was added to the northwest portion of the survey area when it was apparent that ferruginous hawks were nesting there.

* Data from Schmutz 1993

+ Data From Stepnisky et al. 2002

▽ Data from Downey 2005

• Numbers in brackets represent the percent of estimated # of pairs encompassed by half of the confidence interval

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